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(54) Method for controlling the metered amount of detergent in an automatic washing machine or the like

(57) In a clothes washing machine that comprises a washing tub (4) containing a drum (5), and is adapted to carry out a washing and rinse cycle followed by respective water discharge phases, the method calls for:

- during each water discharge phase, the time intervals (Tw, Tr) to be measured, which elapse from the instant in which the water in the tub (4) lowers down to a first level (L2), to the instant in which the water further decreases down to a level (L1); and
- when the ratio (R) between the so measured time intervals (Tw, Tr) is detected to be higher than a given threshold value (Rx), an alarm signal to be generated which is indicative of an excessively metered amount of detergent.

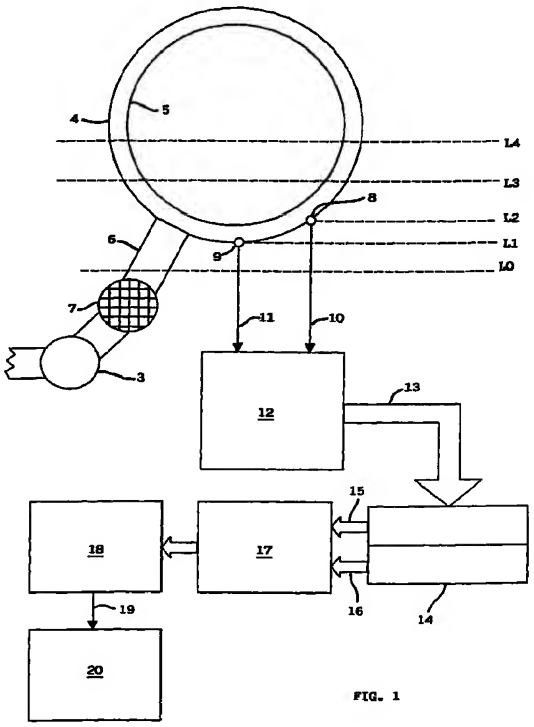

FIG. 1

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Description

[0001] The present invention refers to a method that is capable of being used in an automatic washing machine to the purpose of controlling the operation thereof in such a manner as to be able to detect and indicate a possible state of excessively metered amount of detergent dispensed with respect to an optimum amount.

[0002] Excessively metered amounts of detergent in washing machines are generally known to be connected with and give rise to a number of drawbacks which, further to an excessive usage of washing chemicals, can be summarized as follows:

- environmental pollution;
- possible appearance of allergic skin diseases;
- prolongation of the operating cycles of the machine, under resulting energy wasting effects and increased utilization costs.

[0003] Equally well-known in the art is the fact that the optimum amount of detergent that needs to be metered and used in washing machines depends actually on a number of variable parameters and factors, such as in particular the weight and the actual soiled condition (ie. the amount of soil) of the clothes to be handled, the type of fabrics thereof, the hardness of the water used in the process, and the like. It therefore is quite difficult for anyone to determine in advance the optimum amount of detergent that has to be used under the different conditions, although appropriate tables are generally available to users, in which the amounts of detergent to be used and metered in accordance with the weight of the washload are indicated in an approximative manner.

[0004] Apparatuses and arrangements are known in the art, which can be used to measure the concentration of detergent in the washing liquor. However, these solutions are generally so complex, sophisticated and expensive as to turn out to be practically of no use in, ie. practically inapplicable to home appliances and consumer products in general. Solutions of this kind are known from instance from the disclosures in EP-A-0 193 152 and EP-A-0 193 825, which provide for the use in a washing machine of special sensors of the optical or capacitive type adapted to measure the microscopic characteristics of the micelles and the emulsion in the washing liquor.

[0005] Furthermore, the practice is known from GB-A-2 052 251 of controlling the operation of a washing machine by measuring the surface tension, the hardness, the electric conductivity and the pH of the water in view of appropriately and correspondingly metering the amounts of water and detergent needed to carry out the washing process. Such a solution, further to being particularly complex, turns out practically to be unsatisfactory, since it is based on the detection of factors that are not really indicative of the actual detergency process of the clothes.

[0006] In any case, the above cited prior-art solutions are only applicable if use is made of detergent products that contain surface-active agents, which are currently falling into disuse.

[0007] It therefore is a main purpose of the present invention to provide a simple method for controlling in an accurate and reliable manner the amount of detergent to be metered in an automatic washing or similar machine of a substantially traditional kind.

[0008] More particularly, it is a purpose of the present invention is to provide a method of the above cited kind, which makes it possible for a possible excessively metered amount of detergent to be detected in an indirect manner, that is without any need arising for complex specific auxiliary devices or apparatuses to be employed in this connection.

[0009] According to the present invention, these aims are reached in method for controlling the metered amount of detergent in an automatic washing or similar machine having the characteristics as recited in the appended claims.

[0010] Anyway, features and advantages of the present invention can be more readily understood from the description that is given below by way of non-limiting example with reference to the accompanying drawing, in which:

- Figure 1 is a basic schematical view of a washing machine adapted to implement the method according to the present invention; and
- Figure 2 is a diagrammatical view of the variations in the water level L during significant phases of the method according to the present invention.

[0011] With reference to the above listed Figures, the method according to the present invention can be implemented in a clothes washing machine having a substantially traditional structure, which comprises a washing tub 4 housing a rotating drum 5 adapted to contain the clothes to be washed. The washing tub 4 is connected to a water discharge circuit 6, to which there are associated a pump 3 and a lint filter 7.

[0012] Again in a traditional manner, the clothes washing machine shall be understood as being provided with a plurality of operational and functional parts controlled by a programme sequence control switch or unit, preferably of the electronic type, for carrying out selectable operating cycles, at least one of which comprising at least a washing phase and at least a subsequent rinse.

[0013] The washing phase is carried out with water, to which detergent is properly added and which is let into the washing tub 4 up to a first operating level L3 and

is then preferably heated. Said washing phase is then concluded with at least a water discharge phase lasting from an instant t1 through to an instant t4, during which the water in the tub decreases from said level L3 down to a minimum level L0.

[0014] The rinse phase, which is preferably the last one of a sequence of rinses carried out following the washing phase, is carried out by letting fresh water into the tub 4 up to a second operational level L4, which is preferably higher than said level L3. Said rinse phase is then concluded by at least a water discharge phase lasting from an instant t5 through to an instant t8, during which the water in the tub decreases from the level L4 down to said minimum level L0.

[0015] The present invention is based on the consideration that, with the discharge or drain pump 3 of the machine performing regularly, the time required for the washing and rinse water to be discharged from the tub 4 is in both cases in a correlation with a number of factors, such as in particular the weight of the clothes, ie. the washload, the distribution of the clothes inside the drum 5, the type of fabrics being handled, the actual extent to which the lint filter 7 is clogged. Furthermore, as opposite to what occurs when discharging rinse water, the process of discharging wash liquor is substantially affected by the presence of froth or foam generated by the detergent.

[0016] According to the present invention, a possible excessive amount of detergent being metered into the washing water can be detected quite accurately and reliably in the following manner.

[0017] During the washing water discharge phase t1 - t4, provisions are made to detect a first instant t2, in which the water in the tub 4 decreases to a first reference level L2, as well as a second instant t3, in which the water in the tub 4 further decreases to a second reference level L1, which is obviously lower than said first level L2.

[0018] As illustrated in Figure 1, the moment at which the water reaches down to said levels L2 and L1 can be easily detected through the use of appropriate level sensor means 8, 9, which may for instance be of the pressure-actuated switch type and are adapted to drive a starting input 10 and a switch-off input 11 of a timer 12, respectively.

[0019] In particular, the timer 12 is started when the water in the tub 4 decreases to the level L2 and is switched off, ie. stopped, when the water then decreases down to the level L1. In other words, the timer 12 measures the time interval Tw that elapses from said first instant t2 to said second instant t3.

[0020] In a preferred manner, said level L2 is substantially equal to or lower than the level corresponding to the bottom (ie. the lowest point) of the rotating drum 5, in which "substantially equal to" is to be understood as meaning in practice also "slightly higher than" (eg. 3 to 5 mm), anyway to such an extent as to prevent the water discharge operation from being affected, during the above mentioned measurement time interval Tw, by the clothes being in contact with the water being let off. This practically enables the measurement of the time interval Tw to be substantially cleared from all such variables as the weight of the washload, the arrangement of the clothes inside the drum 5, the type of fabrics.

[0021] In the example being described here, the timer 12 has an output 13, through which it drives, with a signal that is representative of the measured time interval Tw, a double-memory stage 14 in which said measured value Tw is kept stored temporarily.

[0022] Since foam actually affects the operation of the discharge pump 3 of the machine, the time interval Tw should in principle be indicative of the amount of detergent added to the washing water. In practice, however, a simple measurement of this time interval Tw does not allow for a possible excessively metered amount of detergent to be detected in any satisfactorily accurate manner.

[0023] According to the present invention, therefore, during the subsequent discharge phase t5 — t8 of the rinse water (which is substantially free from detergent), provisions are taken to detect a first instant t6, in which the water in the tub 4 decreases to a first reference level (preferably equal to the value of the level L2), as well as a second instant t7, in which the water in the tub 4 further decreases to a second reference level, which is preferably equal to the value of the afore cited level L1.

[0024] As indicated earlier in this description, this may be carried out by means of the level sensors 8, 9 and the timer 12, whose output 13 is adapted to drive the stage 14 with a signal that is representative of the so measured time interval Tr elapsing from said first instant t6 through to said second instant t7.

[0025] Furthermore, respective outputs 15, 16 of the same stage 14 are in turn adapted to drive, with the values of the time intervals Tw and Tr, a computing stage 17 that is adapted to compute the ration $R = Tw/Tr$, as well as to drive, with a corresponding signal, a threshold-value comparator 18.

[0026] When the measured ratio R is so found to exceed a pre-determined threshold value Rx (which may for instance be set at 1.3), the comparator 18 is adapted to generate, at an output 19, an alarm signal that is indicative of a condition of substantial excessive amount of detergent added to the washing water.

[0027] As this has been found also experimentally, in fact, the above mentioned ratio R is affected by the foam that is only present in the washing water, and it therefore is indicative of the amount of detergent added to the same water. Conversely, said ratio R is not altered by any possible reduction in the water flow rate in the discharge circuit 3, 6, 7 (as this might for instance be induced by the lint filter 7 becoming clogged), since such a condition would actually alter both measurement periods Tw and Tr in a similar way.

[0028] Conclusively, it can be stated that such a

ratio R of the above mentioned measurement periods to each other advantageously enables the amount of detergent that is used during washing to be controlled indirectly, but with good accuracy, while making such a measurement independent from variables that might alter it.

[0029] In a preferred manner, the above mentioned alarm signal is adapted to trigger actuator means 20, which in the most elementary embodiment thereof may comprise optical and/or acoustical indicator means, through which the user can be warned of the so detected condition of excessive detergent addition, thereby enabling the same user to step in in view of taking the most appropriate corrective actions.

[0030] Foam formation in the washing liquor, and therefore the sensitivity of the metered detergent amount control system, might be altered in the event that, as this usually occurs, the drum 5 is caused to rotate during the water discharge phases. According to the present invention, therefore, the sensitivity of the above cited control system can be further improved by controlling the washing machine in such a manner as to have, during the washing water discharge phase (and possibly even during the rinse water discharge phase), the rotating drum 5 being kept substantially stationary throughout the measurement period.

[0031] In the example being described here, the reference levels L2 and L1 are controlled by means of pressure-actuated switching means, ie. means that are adapted to be affected by a measured pressure, As a result, towards the end of the discharge phase t1-t4 of the washing water, said pressure-actuated switching means might detect the level L1 being exceeded owing to a corresponding transient negative pressure being induced by the discharge pump 3. The result might therefore be an erroneous indication of a condition of an excessively metered amount of detergent.

[0032] Such a drawback can anyway be advantageously done away with (for instance through a simple setting of the timer 12) by arranging things so as to enable the instant t3 to be only determined, and considered as being valid to the purpose of computing the time interval Tw, when the driving signal issued by the sensor 9 indicates that the water in the tub 4 remains below said reference level L1 for at least a pre-determined period of time, which may for instance amount to a few seconds.

[0033] Therefore, the method according to the present invention enables a possible condition of excessively metered amount of detergent to be identified in a reliable, albeit indirect manner, with an elevated degree of sensitivity, while substantially discriminating the measurements being carried out from all possible spurious signals that might affect the effectiveness thereof.

[0034] It will of course be appreciated that the above described method can be the subject of a number of modifications without departing from the scope of the present invention.

[0035] For instance, the level L1 may be equal to, but preferably it will be slightly higher, for instance by a few millimetres, than the minimum level L0. In any case, the difference between the levels L2 and L1 will preferably be wide enough to allow for an adequately accurate measurement of the time intervals Tw and Tr.

[0036] The ratio R itself may obviously be computed inversely, ie. $R = Tr/Tw$, and in this case the alarm signal will be generated when R is found to decrease below a corresponding pre-determined threshold value Rx.

[0037] According to the case, therefore, said alarm signal is generated when R is found to exceed the threshold value Rx either upwards or downwards.

Claims

1. Method for controlling the metered amount of detergent in an automatic clothes washing or similar machine of the type which comprises a washing tub accommodating a rotating drum for holding the washload, and is adapted to carry out operating cycles including at least a washing phase performed with water to which detergent is added, and which is let into said washing tub up to a first operating level, as well as at least a subsequent rinse phase performed with water that is let into said tub up to a second operating level, said washing phase and said rinse phase being each followed by a respective water discharge phase in which said water is let off the tub down to a minimum level, **characterized in that** it comprises following phases:

   - during said discharge phase of the washing water, provisions are taken to measure a first time interval (Tw) elapsing from a first instant (t2), in which the water in the tub (4) decreases to a first reference level (L2), to a second instant (t3), in which the water in the tub (4) further decreases to a second reference level (L1), which is lower than said first level (L2);
   - during said discharge phase of the rinse water, provisions are taken to measure a second time interval (Tr) elapsing from a first instant (t6), in which the water in the tub (4) decreases to a first reference level (L2), to a second instant (t7), in which the water in the tub (4) further decreases to a second reference level (L1), which is lower than said first level (L2);
   - the ratio (R) of said first time interval (Tw) to said second time interval (Tr) is then calculated; and
   - when the so computed ratio (R) is found to exceed a pre-determined threshold value (Rx), an alarm signal is generated which is indicative of a condition of substantially excessive amount of detergent metered in the washing water.

2. Method according to claim 1, **characterized in that,** during at least one of said water discharge phases, said first reference level (L2) is substantially equal to or lower than the level corresponding to the bottom of the rotating drum (5).

3. Method according to claim 1, **characterized in that** said alarm signal triggers actuator means (20).

4. Method according to claim 1, **characterized in that** said first reference level (L2) is the same during both said water discharge phases.

5. Method according to claim 1, **characterized in that** said second reference level (L1) is the same during both said water discharge phases.

6. Method according to claim 1, **characterized in that** in at least one of said water discharge phases said rotating drum (5) is kept in a substantially stationary condition during said time interval (Tw; Tr).

7. Method according to claim 1, in which said second reference level is controlled by means that are driven by a corresponding signal that is capable of being affected by the presence of foam in the water contained in the washing tub, **characterized in that,** during the discharge phase (t1 — t4) of the washing water, said second instant (t3) is determined when said driving signal is indicative of a condition in which the water in the tub (4) remains below said second reference level (L1) for at least a pre-determined period of time.

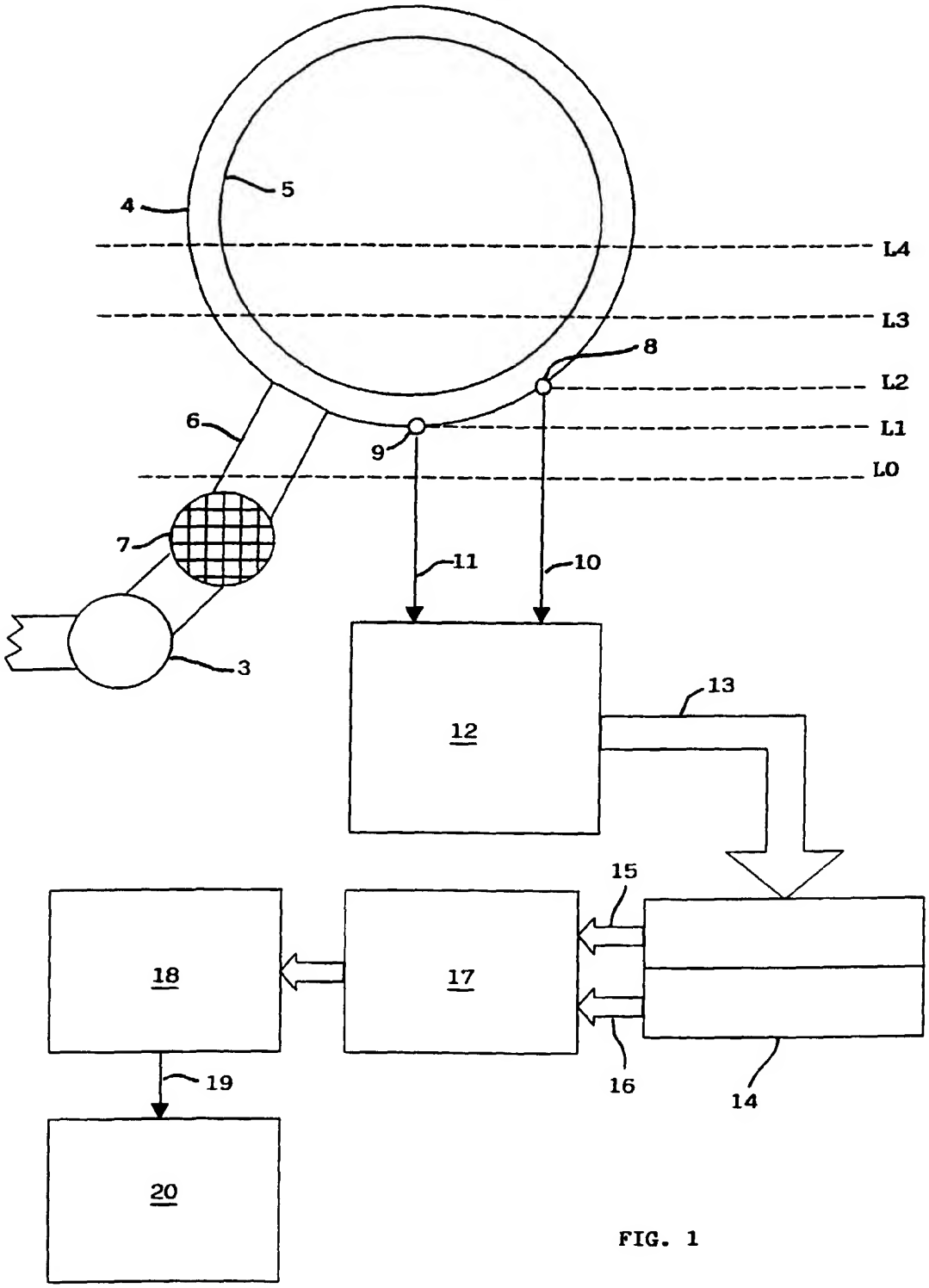

FIG. 1

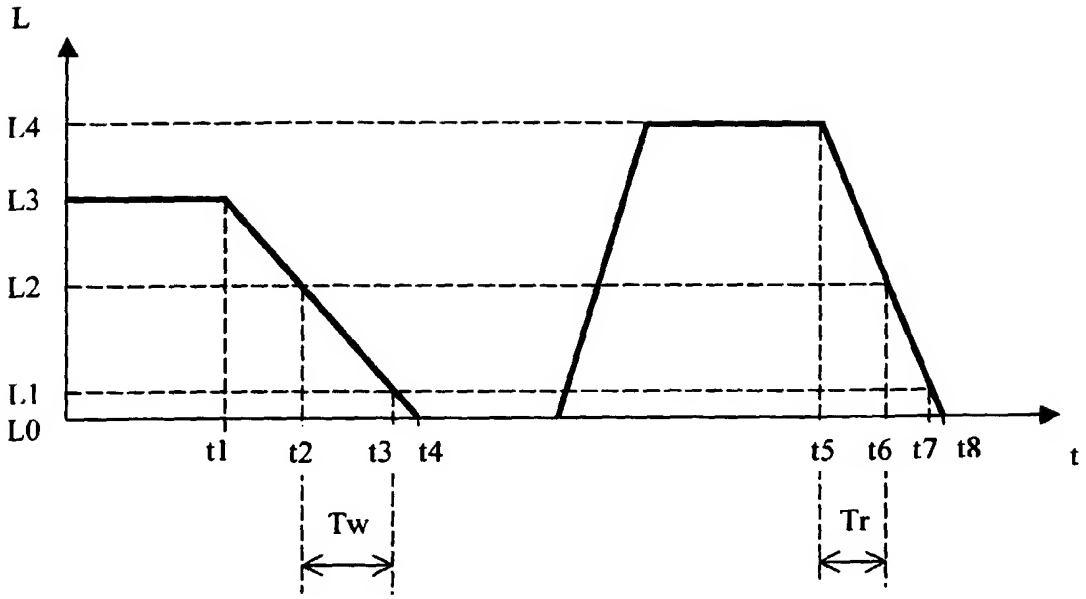

FIG. 2